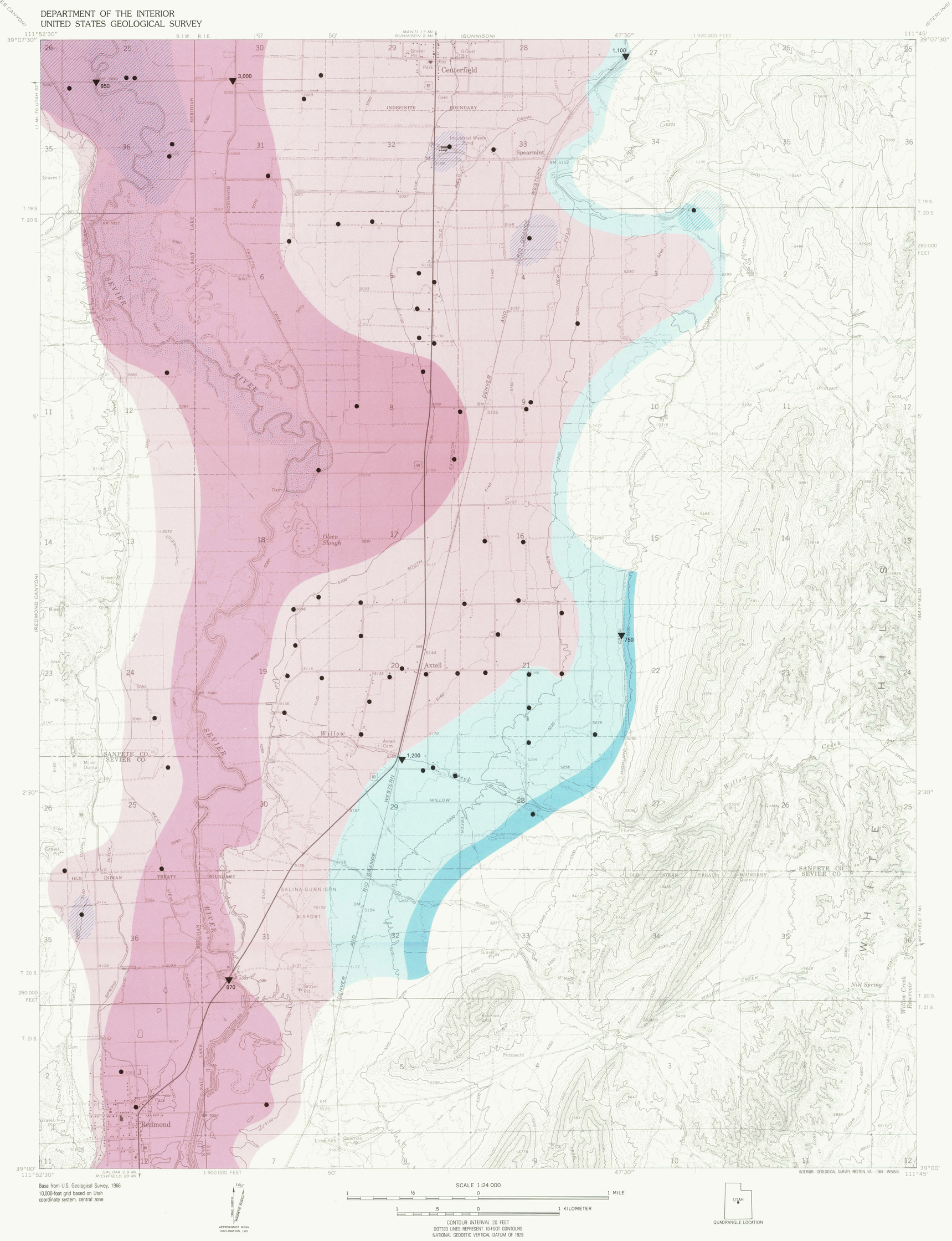
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–1304–B



Base from U.S. Geological Survey, 1966
10,000-foot grid based on Utah coordinate system, central zone

APPROXIMATE MEAN DECLINATION, 1981

SCALE 1:24 000
1 ½ 0 1 MILE
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1981—W80580

SUMMARY APPRAISAL OF WATER RESOURCES IN THE REDMOND QUADRANGLE, SANPETE AND SEVIER COUNTIES, UTAH

By
Don Price

1981

EXPLANATION

GENERAL DEPTH TO WATER, IN FEET BELOW LAND SURFACE

Less than 10
Wells drilled in stippled area probably will flow under artesian pressure

10–50

50–100

More than 100

No data
Depths to water probably vary considerably over short distances in the upland areas

Area in which ground water was reported or determined to be saline. Such conditions probably occur elsewhere in the map area (see text)

Well used to determine depth to water or salinity of the water (Data in Carpenter and Young, 1963)

▼870
Stream or canal section at which general chemical quality of surface water was determined from specific conductance of the water. Number is specific conductance, in micromhos per centimeter at 25°C, as determined February 28, 1980, with a conductivity meter

INTRODUCTION

This map was compiled in conjuction with an energy-related geologic-mapping project of the Redmond Quadrangle (Witkind, 1980) in order to show the general availability and chemical quality of water in the area. The map is based chiefly on data collected by the U.S. Geological Survey under a continuing cooperative program with the Utah Department of Natural Resources, Division of Water Rights, and on cursory field observations by the writer. Most of the existing data are in reports of Carpenter and Young (1963), Hahl and Cabell (1965), Young and Carpenter (1965), and Hahl and Mundorff (1968). Additional information about water and related land resources in the map area may be found in a report of the U.S. Department of Agriculture (1969).

The map is intended for general planning purposes only and needs to be used with discretion. Detailed site-specific information about the availability and quality of water or about water-related problems can be gained only by special on-site investigations.

SURFACE WATER

Normal annual (1931–60) precipitation on the Redmond Quadrangle area is generally less than 10 inches (U.S. Weather Bureau, no date); consequently, little overland runoff is generated in the area. A water-yield map of Bagley, Jeppson, and Milligan (1964, fig. 16) shows that theoretical mean annual runoff from within the area is less than 1 inch (probably much less than 50 acre-feet per square mile.)

The principal sources of surface water in the Redmond Quadrangle are the Sevier River, which originates more than 120 miles south of Redmond, and several irrigation canals. The canals divert water from the Sevier River at various points upstream from Redmond; they include the Sevier Valley-Piute Canal, which is beyond the west boundary of the map area. Some water also enters the map area in Willow Creek, which originates on the Wasatch Plateau about 15 miles east of Axtell.

The volume of surface water entering the Redmond Quadrangle naturally or by canal diversion is not accurately known. The nearest upstream streamflow-gaging station on the Sevier River is near Sigurd, about 12 miles southwest of Redmond; there the average annual flow was about 68,000 acre-feet for 64 years of record between 1912 and 1978 (U.S. Geological Survey, 1978, p. 396). During the irrigation season, practically the entire flow of the river is diverted to canals upstream from the gaging station. Annual diversion to canals that serve the Redmond Quadrangle vary considerably from year to year, depending on the available supply. The maximum, minimum, and average annual diversions during 1968–77 to the three largest canals that serve the area are presented in table 1. An unknown but significant amount of the diverted water is used for irrigation south of the Redmond Quadrangle, and a significant amount is delivered to users north of the quadrangle.

Table 1.—Maximum, minimum, and average annual diversions to three canals that serve the Redmond Quadrangle
[Data from annual reports of the Sevier River Commissioner to the Utah State Engineer]

Canal	Annual diversions (acre-feet)		
	Maximum	Minimum	Average
Sevier Valley-Piute	78,209	30,447	59,771
Rocky Ford[1]	24,710	20,086	23,014
West View	7,795	5,666	6,900
Totals (rounded)	110,700	56,200	89,700

[1]Referred to as Rocky Ford-Willow Bend Canal in Commissioner's reports.

The flow of Willow Creek, which is regulated by Willow Creek Reservoir, is not gaged. Young and Carpenter (1965, table 2) estimate that base flow in the stream upstream from diversions east of Axtell averages about 1,500 acre-feet per year. Virtually all this flow is diverted for irrigation.

The potential for flooding exists locally in the Redmond Quadrangle, particularly along the alluvial plain of the Sevier River and along the alluvial plain of Willow Creek near Axtell. Flooding is most likely to occur during summer cloudbursts, which are common in this region. Several floods have been recorded in the Redmond and Axtell areas as summarized in table 2.

Table 2.—Summary of floods in the Redmond Quadrangle
[Data from U.S. Department of Agriculture, 1971]

Area affected	Stream	Date	Discharge (cubic feet per second)
Redmond	Sevier River	7–14–25	Unknown
Axtell	Willow Creek	8–25–05	Do.
		7–24–25	270
		8–27–29	820
		8–22–46	220

GROUND WATER

Ground water is present in both the consolidated rocks that crop out in the White Hills and other upland areas and in the unconsolidated valley fill that mantles those rocks. Water in the consolidated rocks probably is in a complex system of confined (artesian) and unconfined (water-table) aquifers and the rate of movement to wells and springs probably is slow. Available data from adjacent areas indicate that the consolidated rocks most likely to contain productive aquifers are the Flagstaff Limestone of Tertiary age and the North Horn Formation of Cretaceous and Tertiary age. This is especially true where their permeability may have been enhanced by fracturing and jointing.

The principal source of ground water in the Redmond Quadrangle, however, is the unconsolidated valley fill that underlies the Sevier River valley plain. The fill consists chiefly of interbedded strata of clay, sand, and gravel derived from the adjacent uplands and areas to the south. The aggregate thickness ranges from a featheredge, where the fill laps onto the uplands that border the valley plain, to several hundred feet beneath the Sevier River.

Young and Carpenter (1965, table 5) estimate that about 150,000 acre-feet of recoverable ground water is stored in the unconsolidated valley fill of the Redmond-Gunnison ground-water basin; this basin includes most of the Redmond Quadrangle area. Perhaps as much as 80 percent of the recoverable water, or 120,000 acre-feet, is in the area between Redmond and Centerfield. The valley fill is penetrated by many domestic and stock wells, most of which are less than 100 feet deep and 4 inches or less in diameter. Most of the wells produce a few to several tens of gallons per minute of water. However, the specific capacities of several wells—that is, their discharge rate per unit decline of water level during pumping—indicate that the deposits could yield several hundred gallons per minute of water locally to properly constructed and developed large-diameter wells.

Ground water in the unconsolidated valley fill occurs under both unconfined and confined conditions. Unconfined conditions exist along the margin of the valley where the depth to water generally exceeds 50 feet. Confined conditions exist along the axis of the valley where the depth to water generally is less than 10 feet.

Recharge of water to the unconsolidated valley fill occurs where the water is unconfined and chiefly as a result of seepage from canals, ditches, and irrigated land. The water generally moves from the recharge areas to areas of natural discharge along the alluvial plain of the Sevier River and northward to beyond the map boundary. Natural discharge within the area is chiefly by seepage to the Sevier River and consumptive use by phreatophytes chiefly where the depth to water is less than 10 feet. (See also Young and Carpenter, 1965, pl. 6.)

In addition to the ground water that originates from recharge in the Redmond Quadrangle, a small amount enters the area from the south as underflow in the valley fill. Also, an unknown amount probably enters as underflow from the consolidated rocks—especially those on the east—which probably derive some water from the well-wetted Wasatch Plateau. The average annual sustained ground-water recharge to the area has not been determined, but it is probably small compared to the estimated volume of recoverable water stored in the unconsolidated valley fill.

WATER QUALITY

Water in the Redmond Quadrangle generally ranges from fresh to slightly saline according to the following classifications commonly used by the U.S. Geological Survey:

Classification	Dissolved-solids concentration (milligrams per liter)
Fresh	Less than 1,000
Slightly saline	1,000 to 3,000
Moderately saline	3,000 to 10,000
Very saline	10,000 to 35,000
Brine	More than 35,000

The principal source of salinity (dissolved-solids concentration) in both the surface and ground water is the Arapien Formation of Jurassic age. This formation underlies much of the Redmond Quadrangle (Witkind, 1980) and the Sevier River valley for a few miles south of Redmond. The formation contains large volumes of salt and other evaporite deposits that are readily dissolved by ground water and eventually carried to streams, including the Sevier River.

Mineral constituents leached from irrigated soils also contribute to the salinity of surface and ground water. These mineral constituents enter the ground-water system by deep seepage of irrigation water and enter the Sevier River by return-surface flows (tailwater). Evapotranspiration of the shallow ground water beneath the alluvial plain of the Sevier River tends to further concentrate the dissolved solids and increase salinity in the unconsumed ground water.

Dissolved-solids concentrations of Sevier River water downstream from Redmond generally exceed 500 mg/L (milligrams per liter) as shown by Hahl and Mundorff (1968, pl. 1) and periodically exceed 1,000 mg/L during low-flow periods. This also is probably true of water in the Rocky Ford and West View Canals, which is diverted from the Sevier River about 10 miles upstream from Redmond, and for Willow Creek, which drains areas underlain by the Arapien Formation. Water in the Sevier Valley-Piute Canal (west of the map area) probably contains less than 500 mg/L of dissolved solids—as that water is diverted from a fresher reach of the Sevier River about 32 miles upstream from Redmond. Several on-site measurements of specific conductance made during 1976 in the Sevier Valley-Piute Canal, about 8 miles southwest of Redmond, were less than 500 micromhos per centimeter at 25° Celsius (Cruff, 1977, table 1). This indicates that the dissolved-solids concentration of water in the canal also was less than 500 mg/L.

The available data are insufficient to accurately determine the chemical quality of ground water in the Redmond Quadrangle. Much, if not all, of the water in the Arapien Formation is probably saline and locally briny. Water in the North Horn Formation, Flagstaff Limestone, and younger consolidated rocks may range from fresh to slightly saline in upland areas. Carpenter and Young (1963, table 5) report several freshwater springs issuing from the Flagstaff Limestone and Green River Formation northeast of the Redmond Quadrangle.

Virtually all the water in the unconsolidated valley fill contains at least 500 mg/L of dissolved solids. Although this map shows only a few areas where the water was reported or determined to be saline, there are doubtless many other areas of saline water in the fill—especially in deeper parts of the valley-fill aquifer where the Arapien Formation, as shown by Witkind (1980), underlies the fill. Because of this, any attempts to develop ground water for a use where freshwater is required need to be preceded by an on-site water-quality study, including test drilling to sample and analyze the water.

REFERENCES CITED

Bagley, J. M., Jeppson, R. W., and Milligan, C. M., 1964, Water yields in Utah: Utah Agricultural Experiment Station Special Report 18, 65 p.

Carpenter, C. H., and Young, R. A., 1963, Ground-water data, central Sevier Valley, parts of Sanpete, Sevier, and Piute Counties, Utah: U.S. Geological Survey open-file report (duplicated as Utah Basic-Data Report 3), 34 p.

Cruff, R. W., 1977, Seepage study of the Sevier Valley-Piute Canal, Sevier County, Utah: Utah Department of Natural Resources Technical Publication 58, 31 p.

Hahl, D. C., and Cabell, R. E., 1965, Quality of surface water in the Sevier Lake basin, Utah, 1964: U.S. Geological Survey open-file report (duplicated as Utah Basic-Data Release 10), 24 p.

Hahl, D. C., and Mundorff, J. C., 1968, An appraisal of quality of surface water in the Sevier Lake basin, Utah, 1964: Utah Department of Natural Resources Technical Publication 19, 44 p.

U.S. Department of Agriculture, 1969, Water and related land resources, Sevier River basin, Utah: U.S. Department of Agriculture Cooperative Investigation Report, 248 p.

_____ 1971, Sevier River basin floods, Sevier River basin, Utah: U.S. Department of Agriculture Cooperative Investigation Report, Appendix VII, 113 p.

U.S. Geological Survey, 1978, Water-resources data for Utah: U.S. Geological Survey Water-Data Report UT–78–1, 492 p.

U.S. Weather Bureau (no date), Normal annual and May-September precipitation (1931–60) for the State of Utah: Map of Utah, scale 1:500,000.

Witkind, I. J., 1980, Reconnaissance geologic map of the Redmond Quadrangle, Sanpete and Sevier Counties, Utah: U.S. Geological Survey Miscellaneous Geologic Investigations Map I–1304–A, scale 1:24,000.

Young, R. A., and Carpenter, C. H., 1965, Ground-water conditions and storage in the central Sevier Valley, Utah: U.S. Geological Survey Water-Supply Paper 1787, 95 p.

For sale by Branch of Distribution, U.S. Geological Survey
Box 25286, Federal Center, Denver, CO 80225